NOVEMBER 4 1959

GAS IN INDUSTRY

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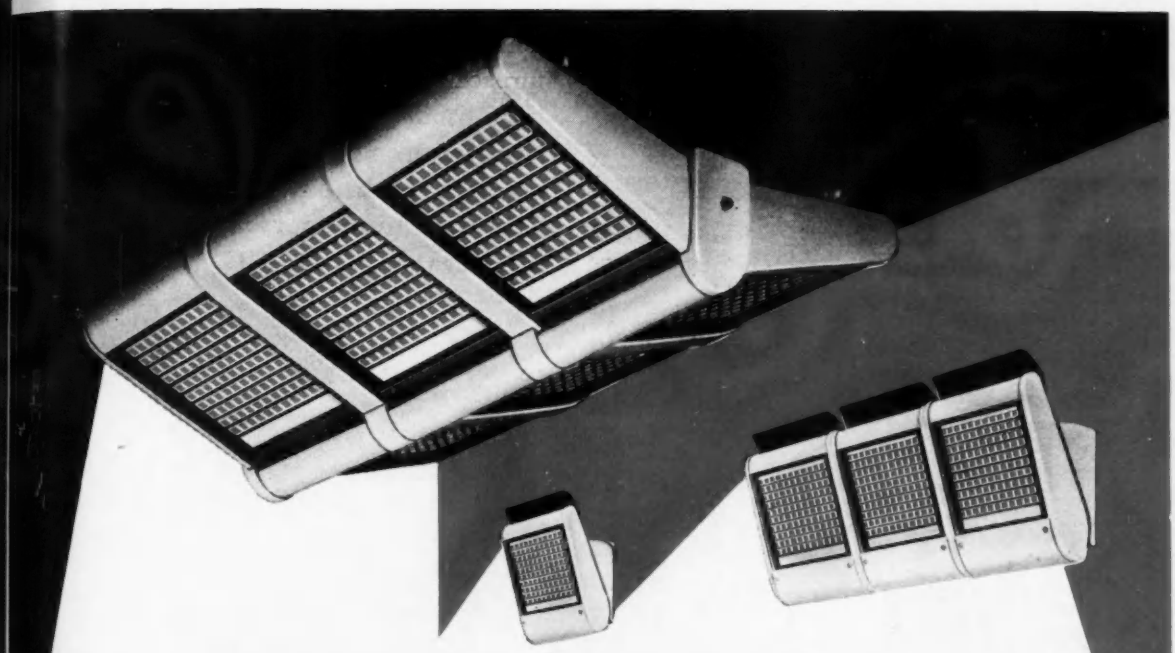

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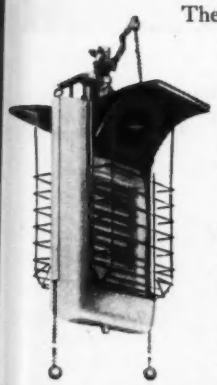

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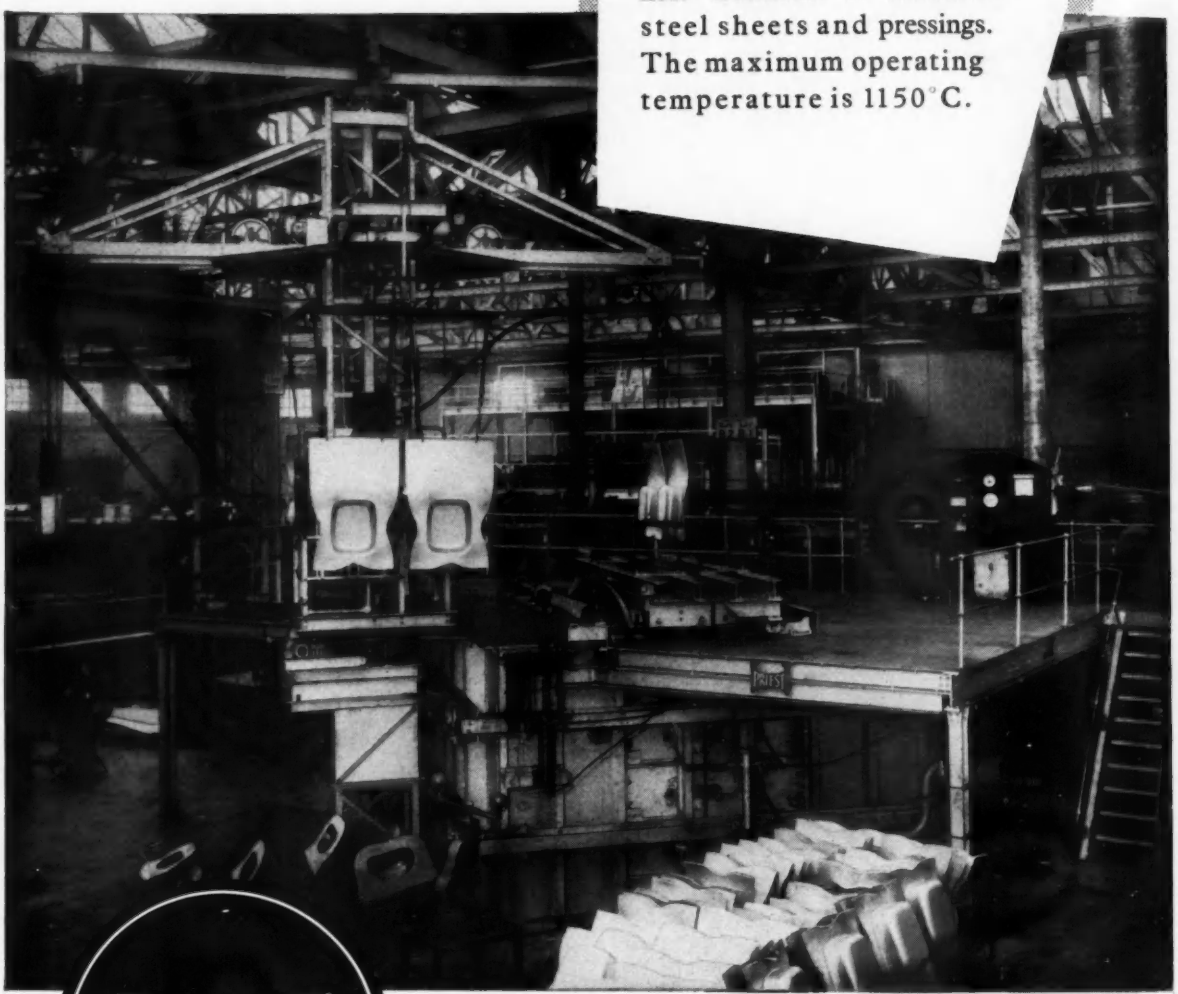

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GAS IN INDUSTRY

NOVEMBER 1959
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FEATURES

GAS IN THE MANUFACTURE OF ELECTRIC MOTORS.
By Eric Ford

HOW GAS HELPS INDUSTRIALISTS TO MEET THE NEEDS OF CURRENT LEGISLATION
By W. F. Howell

GAS COOKING RANGE DEVELOPMENT
By 'GAStronome'

TWO MODERN CANTEEN KITCHEN LAYOUTS

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Editorial

Turning to Gas

THAT it is almost always in the industrialists' interests to turn to gas is beyond dispute, and therefore it is all the more strange that it sometimes takes Acts of Parliament to bring about such conversions. Of course it is the industrial gas salesman's object to make it quite clear to the industrialist that any change from his present method of heating to gas firing is to their mutual advantage.

It is the skill and knowledge of the salesman that convinces the potential purchaser, perhaps at first against what the latter thinks is his better judgment. Later the installation generally proves to be an outstanding success and both parties are completely satisfied. Sometimes, however, the balance may be weighted in the salesman's favour and this often occurs when an Act of Parliament demands certain changes in working conditions in the factory or makes it an offence to pollute the atmosphere.

In this connection, the paper by Mr. W. F. Howell, Industrial Gas Engineer to the Manchester Group of the North Western Gas Board, on 'How Gas Can Help the Industrialist to Meet Requirements of Current Legislation,' which we are publishing this month, is of the greatest interest.

We publish papers from time to time on the great strides being made with the conversion of furnace equipment to gas firing and our reaction in many cases is to ask why was this not done earlier. How could anyone tolerate the mess and the filth of the old furnace? But what caused the change to take place? From Mr. Howell's paper it would be difficult to give any other reason than that legislation often forced the change. Contrary to expectation, if legislation has forced the change, it has also benefited the industrialist every bit as much as the worker on the workshop floor. So many furnaces fired by solid fuel may have been designed in the spacious pre-war days when coal was cheap and fuel costs so small in proportion to total costs that the idea of spending money in this particular direction seemed difficult to justify. With the demands of the 1937 and 1948 Factory Acts, a change to factory conditions which are familiar today, began to take place. The Garrett Report on the foundry industry recommended certain minimum conditions by which the foundry should be kept free from smoke and noxious fumes, while the Clean Air Act made it an offence for any factory to pollute the countryside with dark smoke. Gas-fired furnaces can overcome all the disadvantages of the solid fuel-fired furnace. In every case of conversion not only has the employee found his work more pleasant and safer, but the employer has also profited by lower fuel costs, a more easily controlled furnace, fewer spoilt articles, a greater ease of furnace atmosphere control and a furnace design which fits into modern line production methods. Atmospheric pollution is completely absent. This latter point should be stressed since the pouring out into the atmosphere of sulphur dioxide is just as serious as dark smoke, though this is not specified in the Act. Gas, all other things considered, causes less pollution from sulphur than any other industrial fuel.

GAS

Ovens for large cores

in the making of

ELECTRIC MOTORS

IN the modern world, electric motors can be described as maids-of-all-work, so far as the provision of motive power is concerned. Their applications range from the lightest possible duties, as in the familiar domestic vacuum cleaner, to the donkey-work of powering the heavy machinery of industry. Indeed, it is not too much to claim that, whatever the amount of power required, from the 'fractionals' to many hundreds of horsepower, there is an electric motor to meet any requirements which may include the ability to work safely and efficiently under difficult or hazardous conditions.

Among the many uses of electric motors are countless applications in connection with gas-fired equipment, where they are widely employed for such duties as powering re-circulating fans, furnace conveyor belts and many other vital operations.

It is therefore pleasing to discover that the gas industry can repay these services by assisting one of the world's best-known manufacturers of electric motors in the heat treatment and other operations required in their manufacturing processes. The firm in question is Newman Industries Ltd., at Yate, Bristol, whose products, ranging from the smallest fractionals to giants of 600 horsepower, are currently being exported to no fewer than 64 countries of the world where

By ERIC FORD

the company has sales and service facilities.

An export business of this extent, in addition to impressive sales to the home market, obviously demands the services of a large manufacturing plant. At Yate, some 1,500 workpeople are employed on a 25-acre site, where gas is consumed at the rate of about 200,000 therms a year. This rate of consumption is likely to increase, for the company is fully alive to the value of gas in its operations, which will undoubtedly expand during the next few years.

Production of electric motors on this scale demands the utilisation of modern methods of mass production and assembly. At Newman Industries Ltd., assembly of motors takes place on four separate production lines, allocated on a horsepower basis, so that fractional horsepower motors are assembled on one line, small motors on another and medium and large motors up to 600 horsepower on the other two respectively.

Procedures are basically the same on these four lines, which incorporate the latest techniques of mechanical handling. These assembly lines are housed in spacious, well-lit premises where the gas-fired equipment is especially well laid out.

Some operations are common to all four assembly lines. For example, one press shop, die-casting shop and foundry serve them all.

An important application of gas is

found in the press shop where the laminations for stators and rotors are subjected to a blue annealing process in a gas-fired furnace manufactured by the Incandescent Heat Co. Ltd., of Smethwick. The laminations, which have been previously automatically stamped, are loaded manually on to a conveyor belt which is powered by a variable speed electric motor.

On arrival at the furnace, the laminations first pass into an entry vestibule which is fitted with a gas curtain. The furnace itself is a full muffle installation, gas-fired by 12 radiant heat tubes, six above and six below the conveyor. These tubes run the length of the furnace and operating temperatures are in the region of 850°C.

★ *Automatic*

Annealing takes place in an inert gas atmosphere and the time for work to pass through the furnace averages about an hour. Accurate control of the muffle temperature is constantly maintained at the required temperature by means of a thermostat and relay to a Selas air-gas proportioning device. The muffle atmosphere is controlled by hand, the control panel including temperature recording, air and gas pressure instruments, together with instruments indicating purge gas pressures and speed of the conveyor belt. A system of coloured lights indicates automatic control of the gas burners, i.e., as between maintenance and full rate burning.

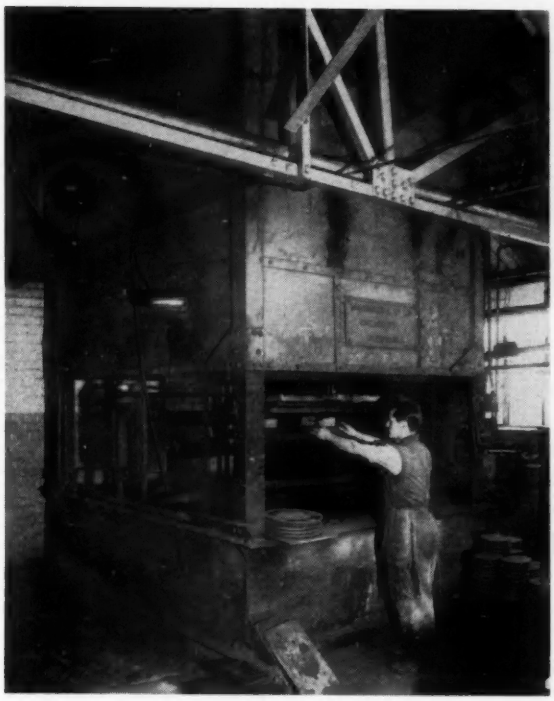
Bright annealing takes place in this furnace from which the conveyor removes the work and carries it through a water-jacketted cooling section which is designed to cool the laminations at a pre-determined rate. It is during this stage that oxidation takes place and the laminations emerge, being now blue annealed. About 12 to 15 tons of work a week pass through this installation, and the standard of annealing achieved is considered to be exceptionally good.

★ *Pre-pressed*

Stator and rotor laminations are now ready for the next stage in the production process, in which they are pre-pressed to maintain a particular size and enclosed in a frame of non-ferrous metal by means of a die-casting process.

There is a variety of gas-fired equipment in this section of the factory, including gas-fired Morgan Crucible furnaces for melting the metal, which is an aluminium alloy. It is also necessary to pre-heat the laminations before they are inserted in the die-casting machine and the metal poured into the die. Among the equipment are several batch-type ovens, typical of which is a rectangular oven fitted with bar-type, natural draft burners. Material for pre-heating is loaded on to a bogie and pushed into the oven for pre-heating to about 300°C. Another smaller oven for pre-heating employs Schwank-type burners and the material is fed down through the oven by gravity.

Many important components of Newman electric motors, such as the body of the motor, end brackets, terminal boxes and the like require to be cast. In view of the importance of these parts to the final success of the motor, the foundry where the casting takes place is of vital importance to



A foundry core stove at the works of Newman Industries Ltd.

Cyanide pots (mainly for tools) in the heat treatment department.

The continuous annealing furnace for annealing stator and rotor laminaions.

the smooth and efficient operations of the entire factory.

In fact, a big programme of expansion is in progress at Newman Industries Ltd., where the present average throughput of 84 tons of light castings a week is planned to rise to 120 tons a week, when the reorganisation is complete. The consumption of gas in this department may therefore be expected to increase correspondingly.

Gas is used in the foundry itself mainly for the pre-heating of the ladles used in pouring the molten metal for casting. There is considerably more gas-fired equipment in such ancillary operations to the foundry proper as the preparation of shell moulds and drying of cores and moulds.

★ *High quality*

Shell moulding, used in the fabrication of such components as motor brackets, is an interesting process and the quality of work produced by this method is of a high order. To obtain the full economic advantages of this method, it is necessary that the production of the shell moulds themselves shall be as efficient as possible.

At Newman Industries Ltd., this process is carried out on apparatus supplied by Reco Engineers Ltd., in which gas is used to maintain the die plate at the required temperature of about 280°F. This degree of heat ensures that the mould mixture of sand and resin material will adhere to the die as it falls by gravity during each operation. The mould is then hardened by means of an electrically-heated hood which is moved into position as each new shell mould is processed. The whole plant is automatic, with the exception of the removal of the finished shell which is carried out by hand. Two moulds formed in this way are then sealed together in another piece of equipment, in readiness for removal to the foundry where pouring takes place.

A large number of cores are employed in foundry operations and these need to be dried after forming and before use in casting. One of several pieces of core-drying equipment is a vertical gas-fired core-drying oven, manufactured by Bagshawe & Co. Ltd., of Dunstable. This oven has been installed in such a way that the upper, or heating, zone rises above the level of the shop floor, which is itself one floor above foundry floor level, while the lower, or cooling, zone is below shop floor level and therefore on the same level as the foundry. This arrangement has certain advantages, as will be seen.

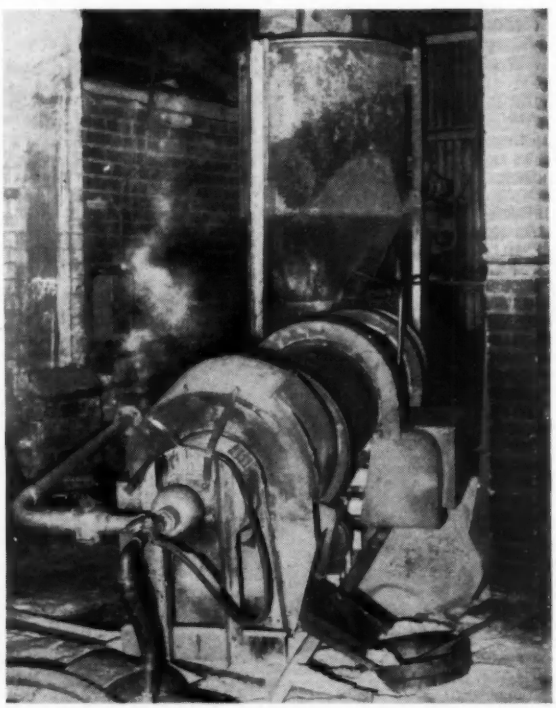
Cores are shaped in the core shop and move along an endless belt towards the entry point of the vertical oven, which is at the mid-point between the upper heating zone and lower cooling zone. Cores are placed on moving trays, fixed to endless chains which carry the trays up into the heating zone on one side and down through it on the other, on a semi-circular route.

★ *Flame failure*

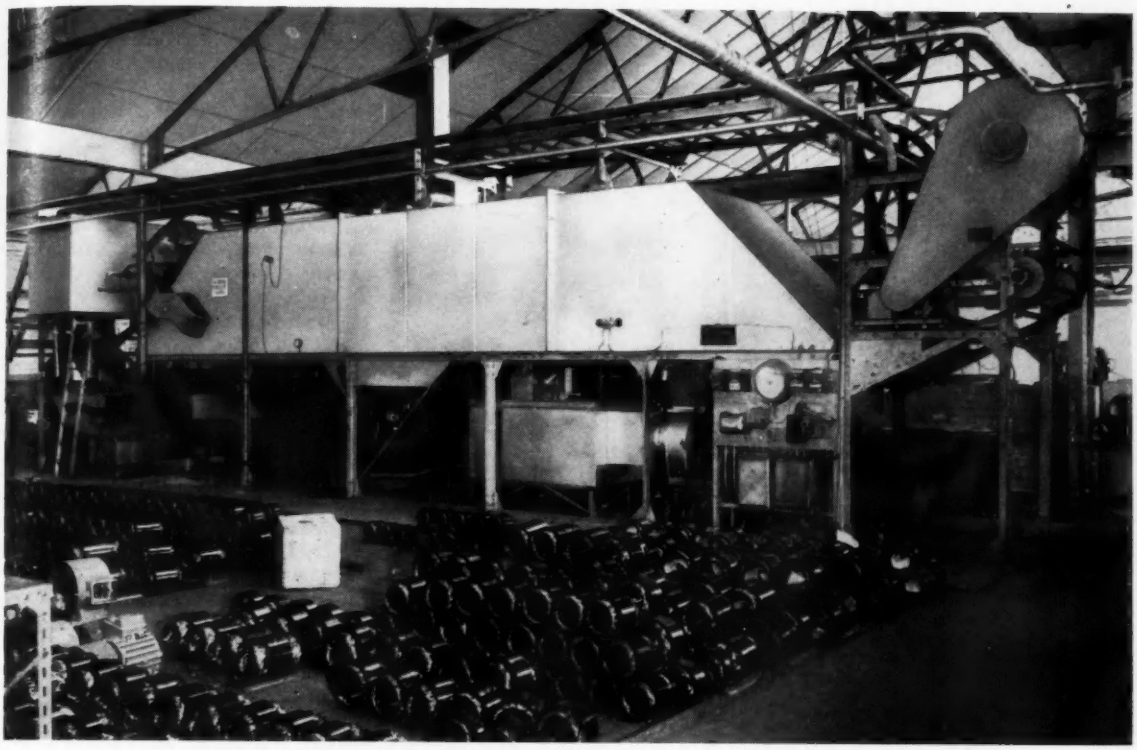
Heat for this zone is provided by four ½-in. jet burners, giving operating temperatures of about 250°F. The oven is fitted with thermostatic control and Perl flame failure device.

As the cores leave the heating zone, they move on their downward path into the cooling zone below and when they reach ground level they can be removed antd transported, without loss of time and with a minimum of handling, to the foundry area for pouring.

Most of the material passing through this oven consists of the smaller cores, of which vast numbers are used in the manufacture of



The foundry sand dryer at Newman Industries Ltd.



A gas-fired Ballard impregnating and stoving oven for impregnating motor stators.

Newman electric motors. These large numbers make it necessary for continuous drying to be employed and, indeed, the entire operation of producing and drying these cores is organised along mass - production assembly-line methods.

Larger items, for which mass production techniques are not so essential, can be dried in batch-type ovens. The available capacity includes two such ovens, both of which are gas-fired by Aeroneat burners. These ovens, 20 ft. × 12 ft., are fired from the rear and are fitted with Perl magnetic controls and flame failure devices. They are sited in the foundry, together with other ancillary equipment such as rotary sand-driers and shot-blasters, which also use gas. Direct-fired, air-blast burners are fitted to the rotary driers, while gas is also employed to pre-heat the shot before it is used in shot-blasting operations.

These and all the other operations in the foundry were being carried on against the background of the wide-scale reorganisation which is taking place. It is not out of place to comment here on the way in which the company is maintaining, and even increasing, its production, at a time when the gradual installation of new equipment places considerable difficulties in the way of the smooth flow of production.

Until now, consideration has been given to the production of the various components which go into the final product. These include such items as the rotors and stators, bodies, and brackets, terminal boxes, bearings, rotor shafts and many other parts, most of which undergo various machining and other processes in the different sections of this large plant.

★ *Machine building*

It should be mentioned in passing, too, that although Newman Industries Ltd., are best-known for their outstanding range of electric motors, the firm also has a large machine-tool rebuilding division, for the repair and rebuilding of many different types of machine tools and other equipment manufactured by leading firms in this field.

In connection with this work, the company maintains a compact and well-appointed heat treatment centre for such important duties as the heat treatment of shafts, gears and other components, as required in the machine-tool rebuilding operations. In this centre, too, such general tasks as tool hardening are carried out.

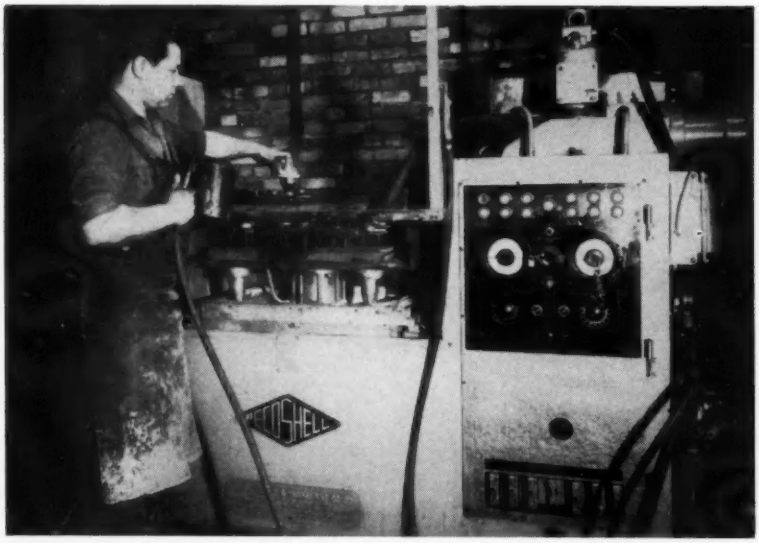
Gas-fired equipment available here includes tempering furnaces, a cyanide pot and a small barium furnace for the treatment of tool steels. All this equipment is in regular use in connection with heat treatment of tools and dies required for various purposes in all sections of the factory. Hardness testers are among the equipment available in this department.

Once the various components of the different types of electric motor are available, there remains the problem of assembly which, as already mentioned, is effected on four main assembly lines. For illustration purposes, the line producing the fractional horsepower motors is described here.

An important preliminary to the assembly of an electric motor is the winding of the stator, which takes place in a separate department adjacent to the assembly line. This operation, involving the winding of thousands of miles of wire in the course of a day, is performed by women and girls who form a not inconsiderable part of the total labour force at Newman Industries Ltd.

After winding, the stators have to be dipped in varnish which has subsequently to be dried. This is accomplished in a gas-fired oven, the equipment on this particular line comprising a camel-back type oven manufactured by F. J. Ballard & Co. Ltd., of Tipton. It incorporates an underslung combustion chamber, providing operating temperatures in the region of about 350°C.

This equipment is entirely auto-



The shell moulding of small motor brackets on a gas-heated platen.

matic, both in respect of purging and light-up arrangements, and in operation. A particularly interesting feature of the oven is that it is now fitted with Newman combustion protection equipment. This is a recent development of the company's own Instrument Division and, being associated with magnetic valve control, is extremely sensitive in operation. This equipment has not long been in use, but there can be no doubt that its future performance will attract wide interest among other users of gas-fired equipment.

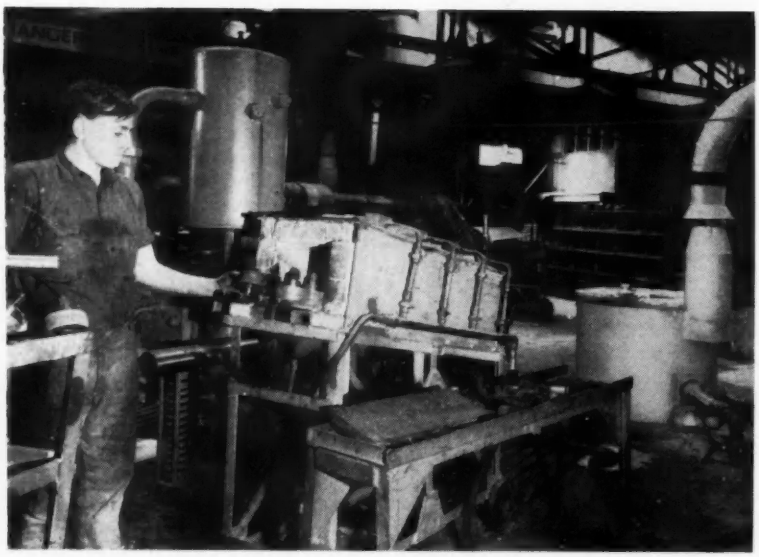
Wound stators on leaving the winding department are placed on hooks suspended from the chain conveyor system associated with the oven. These hooks first lower the stators into a tank of varnish, from which they emerge completely covered with this protection and ready to enter the oven for drying. The time taken to pass through the oven varies with the size of the stator but averages about 1½ hours at 350°F. On leaving the oven, it is only necessary to remove the stators from the hooks and they are ready for the next operation.

Meanwhile, a most important operation is in progress on the rotors, which must be fitted with a shaft on which they will rotate within the stator. This is obviously an operation of great importance for the future safe and efficient running of the electric motor and great care is taken by the company in fitting rotor shafts. The technique employed is heat shrinking and some particularly interesting developments are in hand here, involving the use of gas-fired equipment.

At present, the bulk of this work is being done on an induction heater, but the firm is not entirely satisfied with this equipment and has therefore considered the advantages of gas in this application. Above all, it is desired to replace this existing batch-type equipment with some form of continuous operation, because the heat shrinking of shafts into rotors occurs at a vital point in production at which is is particularly necessary to avoid the danger of a bottle-neck. It is also considered that gas will provide a greater degree of trouble-free operation than with the existing electrically heated equipment.

For this reason, the company, in close collaboration with the South Western Gas Board, has designed an entirely new piece of gas-fired equipment which not only commends itself for originality of conception and design, but illustrates the good results which ensue when an enterprising firm and the local industrial gas engineer get together to attempt to solve a tricky problem.

As at present constructed, this equipment is circular in shape and comprises essentially 26 Schwank radiant heat panels set out in pairs, opposed to each other, round most of the circumference of a circle, erected, conveniently for operation, at easy handling height from the floor. A series of suitable jigs to hold rotors are mounted on a turntable, powered by a variable speed motor, which, as it revolves, moves the rotors slowly between the 26 pairs of opposed radiant heat panels.



A furnace designed and built by Newman Industries for preheating rotors prior to die-casting.

★ *Safety factor*

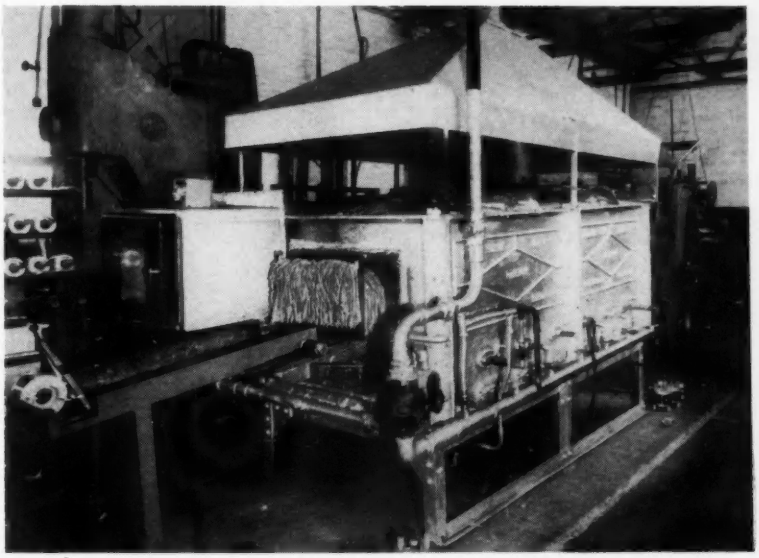
Gas is supplied to the burners via a ring main, the supply of gas to the burners being individually controlled, with a pilot light on each. It would thus be possible to cut out a certain number of the burners if required. A safety factor is provided by a low pressure Keith Blackman valve, providing an automatic cut-off if the pressure falls.

In operation, all the operator has to do is to load rotors on to the empty jigs as they pass slowly in front of him through that section of the circle which is not fitted with burners. Meanwhile,

rotors which have passed between the burners emerge from the last pair of burners and can be removed for the shaft to be fitted.

All sizes of fractional horsepower rotors can be heated in this equipment, which may well find similar applications in due course. Experiments on the equipment are not yet complete, but it is already reckoned that it will prove an extremely useful piece of apparatus for the important task of heat shrinking rotor shafts.

Elsewhere in the works, the heat shrinking of rotor shafts is being carried out in conventional gas-fired equipment, modified for the purpose. This is a muffle furnace manufactured by Incandescent Furnaces Ltd., fired by six burners on either side. The furnace is thermostatically controlled through a Kent two-point recorder-controller. The last two burners at the exit end of the furnace are, however, on hand control, to permit variations in the quantity of heat at this point as required.



Shrinking shafts into rotor cores; this oven heats the rotors before the shafts are inserted.

★ *Conversion*

To convert this furnace into a form suitable for this application, it was raised at the entry end until it was about 7° from the horizontal. Rotors then roll down under gravity from a guide-way at the entry until they emerge at the exit. The procedure is for the operator to remove a rotor at the unloading end, when all the rotors already in the furnace move down to fill up the vacant space. Another rotor then rolls from the entrance guide-way into the furnace.

With the stators wired and the rotors fitted with their shafts, the basic components of the electric motor are complete but there remain the considerable problems associated with the assembly of these major parts into the complete article. It is not the duty of this short survey to describe all these assembly processes, but let it merely be said that the finished electric motor, at the completion of its progress along the assembly line, is then submitted to the most rigorous tests which ensure that every electric motor leaving the Newman works is up to the high standard which the firm has set for itself.

Motors are then spray-painted and, according to present arrangements air dried. Future plans, however, envisage stoving by means of gas-fired equipment, comprising an arrangement of dark emitter panels, which will be installed by Parkinson Cowan Ltd. It is to be an overhead installation, where the sprayed motors will pass from the booth on the Teleflex system to rise sharply to the overslung panels which will be sited in the roof of the building. After stoving, the motors will be returned to a position almost beneath the panels, at floor level, where operators will quickly carry out such operations as the fixing of nameplates. Such an arrangement not only provides efficient automatic stoving but also represents a substantial saving of space.

Gas is not only employed extensively in the firm's manufacturing processes, for the large and well-run canteens use gas for cooking.

Through its close association with Newman Industries Ltd., the South Western Gas Board are naturally aware of the high quality of the electric motors the company produces. It is now the practice of the Board to install Newman's standard flameproof motors at all its existing gas-making stations and elsewhere where these motors can be employed.

For its part, Newman Industries Ltd., look to the Board, in addition to the supply of gas, for the advice and assistance required in connection with this supply. Officers and staff of the South Western Gas Board are ready to provide any services required by the firm, which supplies high-grade electric motors to the world.

An oven for drying motor stator packs at the works of Newman Industries, Ltd.

KNOW YOUR KITCHEN EQUIPMENT

2.—Cooking range development

By 'GASTRONOME'

SELECTION of the type of cooking range for the staff restaurant kitchen is perhaps more important than deciding upon other items of kitchen equipment. It is the 'hub' of the kitchen, often being used for all cooking purposes. Certainly an average of 70% of all cooking is done with it, even when ancillary appliances such as fryers, steamers and boiling pans are used, although in some kitchens designed to cater for very large numbers—say 1,000 plus—these are brought into greater prominence and the range then becomes a specialist item. Under those circumstances it may be additionally used in conjunction with the larger appliances.

Obviously a knowledge of the potential of the cooking range and its development is very worthwhile.

Experience in post-war years has shown that some managements and cooks employed in industrial catering are prejudiced against the solid hotplate range. Why this is so can be attributed only to inexperience in either kitchen craft or large-scale speciality cooking. This in turn is due to the very rapid growth in industrial catering and subsequent employment of staff who, although capable in many respects, lack the background of training on the 'kitchen stove,' as it is traditionally called by the chef.

Correcting influence

This state of affairs is gradually righting itself as trained people entering this side of catering take an expert's interest in equipment.

There are advantages in using either the open hotplate with several burners or the solid hotplate.

It is recommended that the open hotplate be used when the size of cooking pot and burner are related for a given job. For example, a three-gal. pot requiring a burner of, say, 15,000 B.t.u. to give a result in a given time, which is the kind of need likely to be encountered where completion of a cooked meal is required at a specific time. But, of course, such requirements can be met with a solid hotplate.

In the foreground of this picture is a solid top range using Hypact burners. Also shown are two units of the Frymaster deep fat fryer.

The main points to consider in the selection of an open burner hotplate, whether as part of the range or as an independent, free-standing appliance, are the heat input of the burners and their positions. Ideally, each burner would be of a maximum rating of 20,000 B.t.u. per hour, and of being turned down to 2,000 B.t.u. per hour. This would give maximum flexibility, so that cooking pots of up to 4-5 gal. capacity could be brought rapidly to peak heat and then simmered at will. Even spacing of burners is also desirable for flexibility of use.

The solid plate can do all that an equivalent area of the open burner top can do, and in addition will give terrific 'punch' at the bullseye itself —a wonderful asset to the chef who may find himself trying to 'beat the clock.'

This type of hotplate can incorporate Hypact burners, which are fired horizontally, developing the highest temperature at the bullseye plate itself. This gives an increase in temperature of 200°F. over the normal maximum of 900° to 1,000°F. The sides of the hotplate unit are relatively cool and are perfect for simmering. One asset of these solid plates is the ease with which it is possible to move cooking pots around. This seems to be such a help to any cook that it is difficult to understand why women, in the main, are prejudiced against using them!

It is possible to have either drop down oven or swing door oven with either type of hotplate. The oven with the swing door is the direct-fired oven with two side burners, otherwise being similar to the domestic oven design, the products of combustion mixing with the heated air.

Traditional type

The externally heated type of oven has the drop down door made possible by the restricted height. It is similar in type to the old coal-fired range, so well-liked by chefs.

For all general and good class cooking, either oven is perfectly suitable. The choice reverts to the original question: Open burner hotplate or solid hotplate?

In the next contribution it is intended to discuss deep fat frying ranges.

Benham's give two examples of their kitchen planning and layout schemes

BETCHWORTH

A COMPLETELY new staff restaurant and kitchen in an entirely new and separate building, pleasantly situated in the grounds of Brockham Park, has been built for the Beecham Group Research Laboratories Ltd., at Betchworth, near Dorking, Surrey. With the usual amenities, including heating, kitchen and stores, the terraced dining room has a wide view of the countryside, through large full length and full width windows on three sides.

The complete kitchen, which provides for part waitress and part cafeteria service to 160 people, was planned and installed by Benham & Sons Ltd., who also manufactured all the heavy duty cooking equipment, the stainless steel sinks and drainers, and preparation tables.

The following equipment was supplied and installed: A gas heated central pattern range, comprising:—Two Solid-top units, one 'open-flame' burner; one deep fat fryer unit; one bain marie, with pot rack over; double deck Merton general purpose oven; boiling table (stockpot stove); gas heated pressure steaming oven; 24 in. wide salamander grill on short legs for table fixing; cabinet-type hot closet with doors both sides for through service to the counter in the dining room; an 8 ft. 2 in. long service counter, with hot closet section and food service containers, for waitress service, and stainless steel tables, preparation benches, sinks and drainers, floor racking, four-tier pot rack, and kitchen machines.

BETCHWORTH (*Surrey*). *Installed for Beecham Research Laboratories Ltd., the equipment in this kitchen included two Solid-top units (foreground) and a Merton general-purpose oven.*

HARLOW. *On the* **left,** *a view of the kitchen at Standard Telecommunication Laboratories Ltd. Shown is the boiling section with, on the extreme left, a double-deck, gas-heated pastry oven. On the* **right,** *a picture taken from the chef's side of the counter, showing the gas-heated hot closets with food containers. Note the extensive, naturally well-lit dining room.*

HARLOW

THE same company was also responsible for the planning and complete installation of the kitchen and serveries at the Standard Telecommunication Laboratories at Harlow. The kitchens cater for a total of 300 for midday meals; morning and afternoon tea and coffee are prepared at two to three tea stations and distributed to offices by trolley.

The self-service counter of the main dining room on the first floor has tea and coffee apparatus, a stainless steel sneeze plate with a shelf over, and a full-length tray and barrier rail.

The kitchen is equipped with a three-unit Solid-top boiling table with bain marie, and a service counter hot closet for the lift service to the dining room on the floor above.

How gas can help the industrialist to meet requirements of current legislation

by

W. F. HOWELL

Assoc.M.C.T., M.Inst.Gas E., M.Inst.F.

INDUSTRIAL ENGINEER,

MANCHESTER GROUP,

NORTH WESTERN GAS BOARD

PARLIAMENT issues a considerable number of legislative measures which are aimed at improving the safety, health and welfare either of selected groups of individuals or of the community at large.

To industrial engineers such regulations may have important significance in either of two ways. First they may impose upon us an obligation to ensure that any gas installation with which we are dealing conforms to certain required standards of safety. Secondly, they may offer us an excellent opportunity to assist industrialists to comply with their own obligations under the Acts, by installing appropriate gas-fired appliances.

Safety aspect

With regard to the safety aspect of gas installations, the industry is fully alive to this responsibility; the closest co-operation is maintained between the Industrial Gas Development Committee and the appropriate personnel of the Factory Department of the Ministry of Labour to ensure that the most suitable practicable safeguards for gas installations are recommended. In this connection mention should be made of the Committee's review of flame protection practice and the work by the Midlands Research Station on explosion reliefs.

The principal Acts dealing with safety, health and welfare in industrial premises are the 1937 and 1948 Factories Acts. In addition to these two main Acts there are a large number of separate regulations which are made by the Minister of Labour and National Service by virtue of powers conferred upon him by various sections of the two Factories Acts. Over 87 of such statutory instruments or orders have been introduced since the passing of the 1937 Factory Act and 63 earlier statutory rules and orders are still in force. These are published collectively in Factory Orders by H.M.S.O. and the standard text book on the subject is *Redgrave's Factories, Truck and Shops Acts.*

The main requirements under the 1937 Factory Act which give us the opportunities for increased gas sales were covered at the time the Act was introduced by the B.C.G.A. publication *The Factories Act, 1937—Help in Complying with its Conditions.* The requirements include clauses relating to temperature, washing facilities, and accommodation for clothing. In addition the clause, insisting on periodical annealing of chains, has resulted in additional gas furnaces being installed at firms carrying out chain annealing.

Although it is now 22 years since this Act came into operation its provisions are still applicable to all factories both existing and new and it is considered appropriate to detail the more important clauses which are relevant to the subject of this paper. The clauses are given herewith together with brief observations.

SECTION 3. (1) *Effective provision shall be made for securing and maintaining a reasonable temperature in each workroom, but no method shall be employed which results in the escape into the air of any workroom of any fume of such a character and to such extent as to be likely to be injurious or offensive to persons employed therein.*

(2) *In every workroom in which a substantial proportion of the work is done sitting and does not involve serious physical effort, a temperature of less than 60°F. shall not be deemed, after the first hour, to be a reasonable temperature while work is going on, and at least one thermometer shall be provided and maintained in a suitable position in every such workroom.*

(3) *The Secretary of State may, by regulations, for factories or for any class or description of factory or parts thereof, prescribe a standard of reasonable temperature (which may vary the standard prescribed by the last foregoing subsection for sedentary work) and prohibit the use of any methods of maintaining a reasonable temperature which, in his opinion, are likely to be injurious to the persons employed, and direct that thermometers shall be provided and maintained in such places and positions as may be specified.*

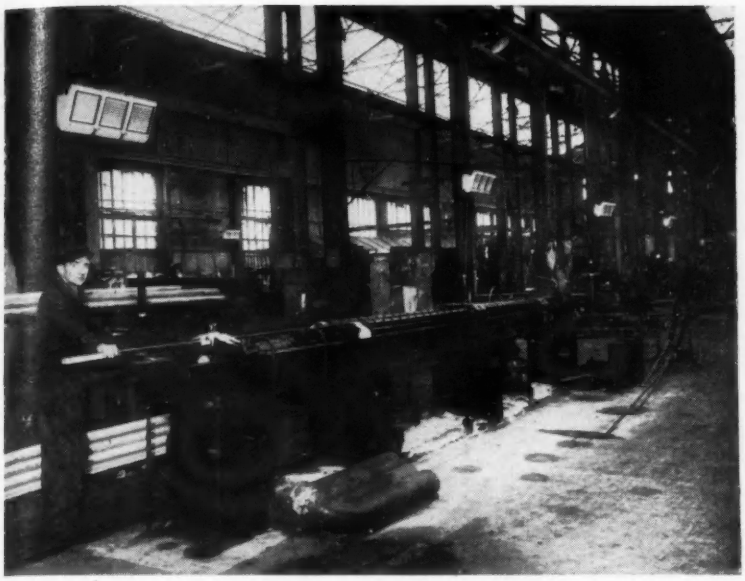
Minimum temperature

While no general regulations have been made under (3) with regard to temperatures for non-sedentary work, there are regulations which have been issued both before and after this Act for at least six industries which do specify a minimum temperature, generally between 50-55°F.

A publication by the Ministry of Labour entitled *Heating and Ventilation in Factories* describes various systems of heating factories including gas-fired unit heaters and overhead gas radiant heaters.

Undoubtedly as a direct result of

From a paper to the Sixth Gas Sales & Service Conference, Harrogate, October 6/7, 1959.



Installation of 40 overhead gas-fired radiant heaters in a large engineering works.

the requirements for workshops to be maintained at a reasonable temperature, a large number of installations for the space heating of factories have been obtained for gas. In many instances the claims of overhead gas-fired radiant heaters are overwhelming on grounds of initial cost, running costs, rapid heating from cold, localised heat where required by the operatives, no floor space required and low maintenance.

Striking testimony

A recent order secured by the North Western Gas Board was for the heating of 11½ acres of workshops at the Cammell Laird works at Birkenhead with overhead radiant heaters. This will probably be the world's largest installation of its kind and is a striking testimony to the appreciation of the advantages of gas-fired overhead heaters for industrial space heating.

SECTION 42. (1) *There shall be provided and maintained for the use of employed persons adequate and suitable facilities for washing which shall include soap and clean towels or other suitable means of cleaning or drying, and the facilities shall be conveniently accessible and shall be kept in a clean and orderly condition.*

(2) *The Secretary of State may by regulations prescribe, either generally or as respects any class or description of factory or as respects the persons employed in any process, a standard of adequate and suitable washing facilities.*

No. 5 in a series of booklets on safety, health and welfare published by the Ministry of Labour and National Service deals with cloakroom accommodation and washing facilities in factories.

This booklet lists special regulations and welfare orders for 25 different industries specifying minimum standards of washing accommodation, and for eight different industries requiring provision for bathing accommodation.

The gas industry has many appliances to offer for these purposes—storage water heaters, single and multi-point instantaneous water heaters and even shower bath cubicles.

SECTION 43. (1) *There shall be provided and maintained for the use of employed persons adequate and suitable accommodation for clothing not worn during working hours, and such arrangements as are reasonably practicable or, when a standard is prescribed, such arrangements as are laid down thereby shall be made for drying such clothing.*

Individual cabinets

The most satisfactory way of drying clothing is probably the installation of heating pipes under the clothes being dried, but individual gas-heated clothes drying cabinets are also available.

The Factories Act, 1937 (Extension of Section 46) Regulations, 1948, extended the scope of Section 46 of the main Act to include arrangements for canteens. Regulations which have subsequently been introduced which contain provisions relating to canteens are: The Jute (Safety, Health and Welfare) Regulations, 1948; the Clay Works (Welfare) Special Regulations, 1948; and the Building (Safety, Health and Welfare) Regulations, 1948.

Publications by H.M.S.O. on canteens include No. 2 in the new series of safety, health and welfare publications—*Canteens and Messrooms for Small Factories.*

Valuable recommendations

In 1945 a Committee was appointed on the suggestion of Sir Wilfred Garrett, then chief inspector of Factories, to consider methods of improving general working conditions in iron-foundries. In 1947 its findings were published by H.M.S.O. as the *Report of the Joint Advisory Committee on Conditions in Ironfoundries.* This publication, commonly known as the 'Garrett Report' made many valuable recommendations on improving working conditions in iron foundries and most of these recommendations were embodied in the Iron and Steel Foundry Regulations, 1953.

The importance of these regulations to industrial gas engineers was that open coal, coke or wood fires were forbidden for space heating, drying or heating ladles, or mould drying. Other pertinent clauses include one that mould stoves, core stoves, and annealing furnaces should not cause offensive fumes to enter the workroom and another that adequate facilities should be available for washing, and arrangements for drying clothes provided.

Important clauses

The important clauses from the industrial gas engineers' point of view are as follows:

SECTION 7. (1) *Open coal, coke or wood fires of a portable nature should not be used for the purpose of heating workrooms.*

Although in many parts of a foundry the problem is to prevent the temperature becoming unreasonably high, it has been common practice to use open solid fuel fires or braziers for space heating. The gas industry can offer the ideal solution for warming many foundries—the use of overhead gas radiant heaters with all their advantages of localised control, saving of labour, saving of floor space, freedom from dirt, smoke and objectionable fumes, and their very economical running cost.

SECTION 7. (2) *Open coal, coke or wood fires shall not be used for heating or drying ladles inside a workroom unless adequate measures are taken to prevent as fas as practicable, fumes or other impuri-*

ties from entering into or remaining in the atmosphere of the workroom.

The commonest method of drying and heating ladles used to be by a coke or wood fire lit inside or in a brazier suspended in the ladle. For many years, however, the use of gas for ladle drying has been finding increased popularity. Not only is gas smokeless, but it requires no labour, is quicker, cleaner, more flexible, more reliable and in a well designed installation more economical.

Small ladles are usually inverted over gas burners, while for larger ladles burners are lowered into the ladle.

Comparative figures

In addition to proprietary makes of ladle dryers on the market, several types have been designed by the industrial staffs of area boards including the East Midlands, Northern, North Western and Eastern Boards.

In a recent paper to the Combustion Engineering Association by J. A. Grainger, comparative figures were given for oil and gas for ladle drying; he showed that gas was about ½-⅝ the cost of oil firing and attributed this to the fact that the gas flame can be projected right inside the ladle and allowed to wash over the surface of the lining.

SECTION 7. (3) *No open coal, coke or wood fires shall be used for drying moulds except in circumstances where the use of such fires is unavoidable.*

Subsequent to the passing of the regulations a committee was set up to examine the drying of moulds by portable dryers and in their report they gave the following figures:

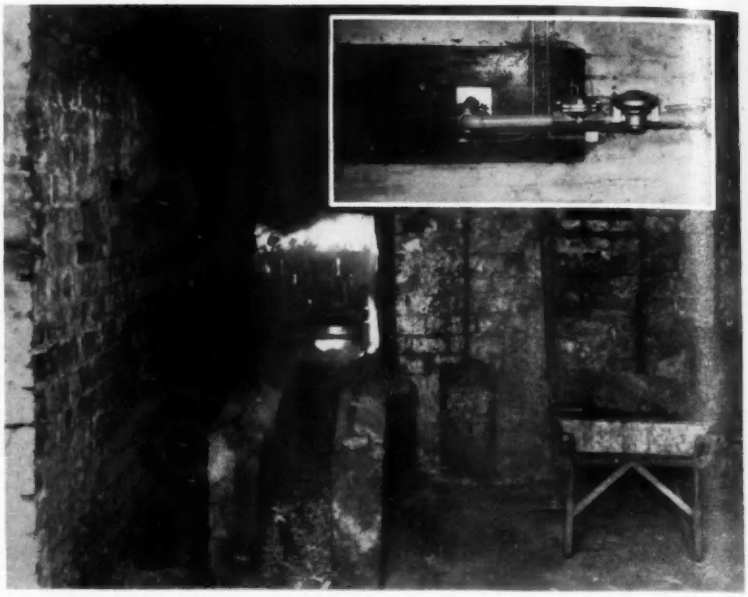
(*a*) Where open coke braziers had been used for drying enclosed moulds, CO/CO_2 ratios of up to 0.22 were obtained.

(*b*) Portable fan blown dryers using coke should not have a higher CO/CO_2 ratio than 0.05 within five minutes of recharging.

(*c*) A portable fan blown gas-heated dryer had a maximum CO/CO_2 ratio of only 0.008.

Although this committee's main reason for condemning the open solid fuel brazier was the high emission of carbon monoxide, they also drew attention to the discomfort from the sulphur dioxide. Gas-fired portable mould dryers not only produce no objectionable fumes, but they are cleaner, lighter in weight and much more easily controlled.

Such a dryer was designed by the North Western Gas Board. Results obtained on an installation were that, with a mould measuring 5 ft. by 3 ft. by 3 ft. and sand thickness 8 in.-12 in. with a wet weight of 15 cwt., satisfactory drying was completed in 4½ hours with a gas rate of 100 cu.ft. Comparable oven drying time was 16 hours.



Dirt and smoke arising from solid-fuel firing. (Inset) Gas-fired burner which doubled output and reduced running cost by 40%.

Mould and core stoves

SECTION 7. (4) *Mould stoves, core stoves, and annealing furnaces shall be so designed, maintained, constructed and worked as to prevent, as far as practicable, offensive or injurious fumes from entering into any workroom during any period when a person is employed therein.*

The use of gas for heating mould and core stoves not only ensures that no fumes shall be created by the fuel, but it is so flexible and easily controlled that it is generally a simple matter when using gas in a correctly flued appliance to ensure no core binder fumes escape into the workroom.

A vertical core stove converted from solid fuel to gas-firing had been a bottleneck in the foundry and was responsible, when on solid fuel, for obnoxious fumes, both from the fuel and the corebinder. From the start, the gas-firing was an unqualified success, particular advantages being:

(*a*) Any required temperature is maintained with no appreciable variation.

(*b*) Output increased.

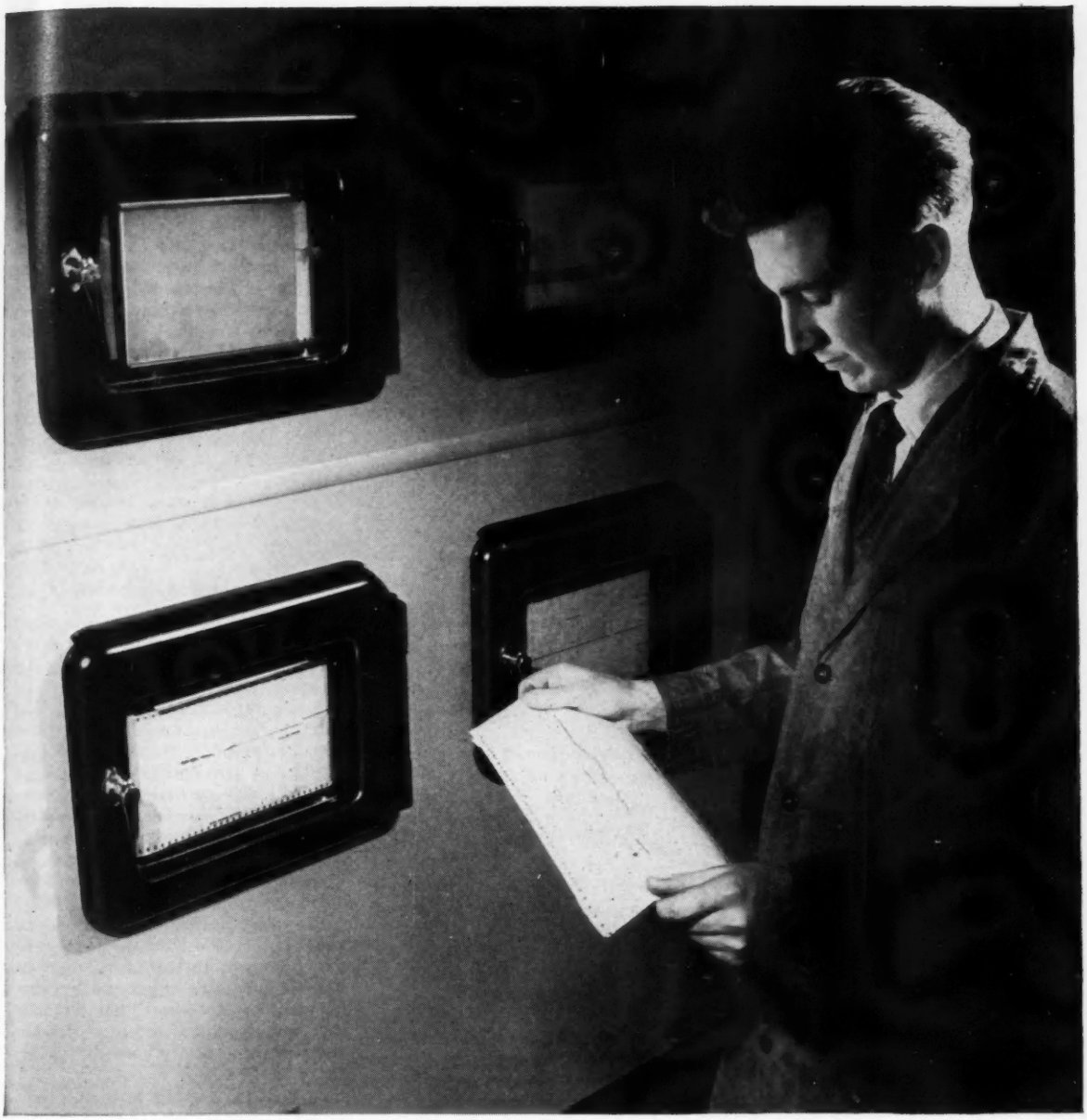
(*c*) The gas-firing, together with an adjustment of flue dampers, prevents any fumes from coming into the core shop. The working conditions of the employees are thus considerably improved, so meeting the requirements of the Act.

(*d*) The absence of solid fuel and ashes makes the working space much cleaner.

(*e*) The life of the refractories is much longer than with solid-fuel firing. (With the latter, the firebox had to be rebricked every month.)

Comparative results are obtained as follows:

	Solid fuel	*Gas*
Temperature	300-520°F.	Any range up to 600°F.
Max. temp. variations	200°F.	10°F.
Weight of cores per day (ten hours)	4 tons	7 tons
Fuel consumption per day	½ ton	63 therms
Fuel consumption per lb. of cores	0.125 lb.	0.004 therms
Time of core in heating zone	1¼ hours	1 hour
Time to reach working temperature (oven loaded)	2½ hours to 450°F.	1½ hours to 480°F.
Man's time attending to heating, etc., per day	10 hours	10 minutes



He reads it easily

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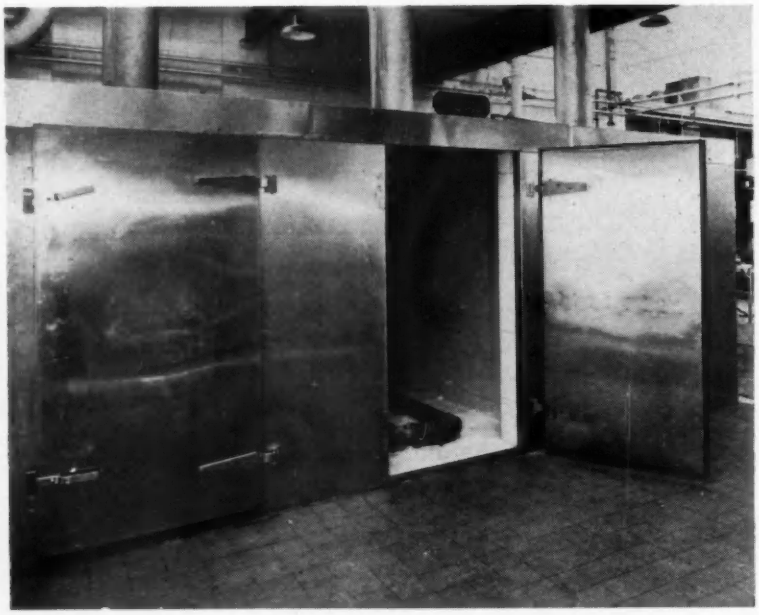

Gas-heated smoke houses with external smoke producing units, used for continental sausage. Less smoke pollutes the atmosphere than with old type of smoke house.

SECTION 9 of these Regulations is a re-enactment of sections 42 and 43 of the 1937 Factories Act and stipulates that provision must be made for bathing facilities and for drying clothes. For the smaller foundry one or more multi-point water heaters will supply hot water for one or two showers as well as for washbasins. For the larger foundries gas-heated storage systems are ideal for the purpose, while gas-fired central-heating boilers will keep the whole of the amenities block warm and provide satisfactory arrangements for drying clothes.

Lighting cupolas

Needless to say, there are many other uses for gas in a foundry than those to meet the requirements of the Iron and Steel Foundry Regulations, e.g., metal melting, vitreous enamelling, hot blast for cupolas, shell moulding, etc. Two uses of gas in a foundry which may help it to conform with the requirements of the Clean Air Act are the lighting of cupolas and the ignition of cupola waste gases.

At one time most cupolas were ignited by using rags soaked in paraffin and several hundredweights of wood. Apart from the cost and the smoke and fumes produced, the resultant drop of the charge in the cupola as the wood burned away was considered by many foundry managers to be prejudicial to the quality of the resultant metal. The use of a gas cupola lighting burner ensures quicker, cheaper and more positive lighting, with no sudden drop in the charge and with a great reduction in the smoke and fumes produced.

The Iron and Steel Foundries Regulations relate, of course, solely to foundries casting ferrous metal. There has, however, been a joint standing committee appointed by the Chief Inspector of Factories to report on the safety, health and welfare conditions in non-ferrous foundries. Its Committee published its first report in 1957. Its recommendations on most aspects relevant to industrial gas engineers are similar to those made in the Garrett Report on ironfoundries and it may well be that at some future date they will become statutory obligations.

A committee was also appointed by the Chief Inspector of Factories to report on conditions in the drop forging industry and it published its report in 1953. Beyond the recommendations for washing facilities there does not appear to be any new opportunities for increased gas usage arising from the report. Gas, however, when used in correctly designed forging furnaces can often play a big part in improving the forge atmosphere and general working conditions, and these are some of the main aspects where the committee consider improvement is necessary.

Overcoming hazards

Part V of the Shipbuilding and Ship Repairing Regulations deals with precautions against asphyxiation, injurious fumes or explosions. The hazards mainly arise in the use of acetylene and bottled gases, together with oxygen for welding, cutting, etc. Particular hazards arise where odourless gases are used in confined spaces, escapes of such a gas as propane (which has no distinctive odour) can give rise to explosives mixtures, while escapes of oxygen can give rise to an oxygen enriched atmosphere in which a spark may cause a workman's clothes to burst into flames. Several fatal accidents have arisen from one or other of the causes.

In order to overcome these hazards the Wirral Group of the North Western Gas Board developed and patented a high pressure air torch for preheating steel plates in shipbuilding. It is so designed that the air induces the gas, and the pressure in the flexible gas tube has to be sub-atmospheric before any gas will pass. Consequently leaks in either the air or the gas flexible tubes can present no danger.

Thermal insulation

Under the powers conferred upon him the Minister of Power made the Thermal Insulation (Industrial Buildings) Regulations, 1958.

Briefly these Regulations imply that local authorities should not approve plans for proposed industrial buildings unless they are constructed so that the walls and ceilings have a thermal conductance not exceeding 0.3 and that no insulation material of an inflammable type is used in their construction.

As fuel technologists, industrial gas engineers cannot but welcome such a fuel-saving regulation as this. For while less fuel will be used, the disparity between the cost of heating with such a refined fuel as gas and a cruder fuel will be decreased, and the user may well agree that the many advantages of gas are well worth the reduced extra cost.

SECTION 15 of the Finance Act, 1956, suspends investment allowances with two exceptions:—

(*a*) *Expenditure incurred in adding, to any building, structure, machinery or plant in the United Kingdom which is or has been already in use, any insulation against loss of heat.*

(*b*) *Expenditure incurred on providing, by way of modification or replacement of plant in the United Kingdom which is or has been already in use, plant of any description prescribed for this purpose in the interests of fuel economy.*

Industrial engineers are often able to help their clients by reminding them of the allowance for insulating buildings and plant.

The Clean Air Act of 1956 has pro-

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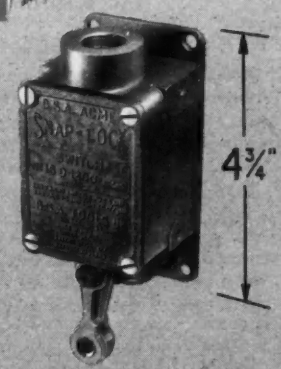

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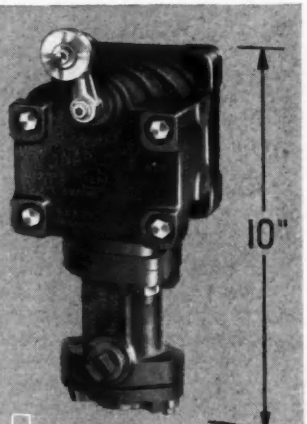

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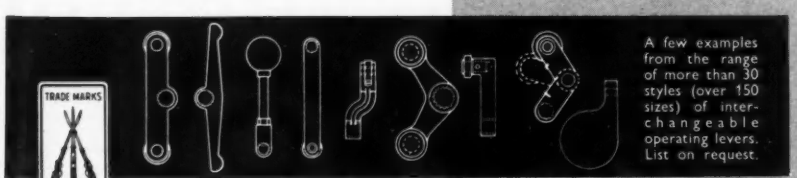

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vided the gas industry with the greatest opportunity it has ever had freely presented to it for increasing the sales of both gas and coke in industrial and commercial premises as well as domestic.

The contribution which town gas can make to ensuring that the requirements of the Clean Air Act are met is immense. With the exception of electricity and liquid petroleum gases, town gas is the only heating medium in general use which does not emit under any circumstances smoke, or grit and dust; in addition, the amount of oxides of sulphur produced is negligible.

All of the Act is of vital importance to the sales staff who should be fully conversant with it, but for the purpose of this paper only a few of the more important sections are dealt with below.

SECTION 1. *Subject to the provision of this Act, dark smoke shall not be emitted from a chimney of any building, and if, on any day, dark smoke is so emitted, the occupier of the building shall be guilty of an offence.*

Arising from the operation of this clause many enquiries have already been received by Boards throughout the country. Very often the industrial gas engineer is able to put forward a scheme which not only overcomes the problem of smoke emission, but provides the user with many other advantages not the least of which may be an overall reduction in running cost.

Smoke problem

A factory in the Manchester area was causing a considerable smoke problem. Illustrated in these pages are the conditions before and after the conversion of coal-fired grease kettles to gas-firing. Not only was the smoke completely abolished, together with all attendant labour and dirt, but the output was increased by 100% and the cost per batch for fuel only was reduced from 25s. to 15s. At the same time the operator on the charging platform was given finger-tip control of the rate of heat input.

In another works coal-fired furnaces were used for the bending of glass for roof lights, curved shop windows, etc. Regular complaints of black smoke nuisance were received from the local authority and from surrounding residential property. In collaboration with the South Lancashire Group of the North Western Gas Board the firm converted to gas-firing a furnace with internal dimensions 26 ft. long by 18 ft. wide by 6 ft. 6 in. high. From a technical point of view, it was an immediate success, the results surpassing anything the factory had previously experienced. By the end of the following year all the firm's furnaces had been re-designed and rebuilt for gas-firing.

SECTION 3. (1) *Subject to the provisions of this section, no furnace shall be installed in a building or in any boiler or industrial plant attached to a building or for the time being fixed to or installed on any land unless it is so far as practicable capable of being operated continuously without emitting smoke when burning fuel of a type for which the furnace was designed, and any person who installs a furnace in contravention of this subsection or on whose instructions a furnace is so installed shall be guilty of an offence.*

Gas-fired furnaces will, of course, always meet this requirement of the Act and local authorities would have no hesitation in approving of such appliances under this section.

Incineration

One particular source of smoke nuisance which in the past has been difficult to overcome is the incineration of certain organic materials. It is, therefore, very gratifying to know that three proprietary makes of gas-fired incinerator which will burn a wide range of materials smokelessly have appeared on the market. One uses a catalyst to oxidise any smoke and another acomplishes the removal of smoke by the use of a secondary combustion chamber. Such incinerators have been successfully used for a wide range of material from scrap rubber to general refuse at a zoo.

Two of the firms making incinerators also manufacture gas-fired cremation furnaces which are smokeless in operation—Gibbon Askam Ltd. make the Diamond cremator developed by the West Midlands Gas Board, while Dowson & Mason Ltd., manufacture the Negas cremator originally developed by the North Eastern Gas Board.

SECTION 11. (1) *Any local authority may, by order confirmed by the Minister, declare the whole of the district of the local authority or any part thereof to be a smoke control area.*

The Smoke Control Areas (Authorised Fuels) Regulations, 1956, lists authorised fuels as follows: Anthracite, briquetted fuels carbonised in the process of manufacture, coke, gas, electricity, low temperature carbonisation fuels, and low volatile steam coals. The absence of oil fuels from this list is significant!

In the smoke control areas and in smokeless zones the reuirements are very stringent—no smoke may be emitted, apart from certain exemptions. Many local authorities apply this section of the Act not only to the burning of the fuel, but to the ignition as well—thus opening a wide market for gas ignition torches of all types.

Other benefits

When a smoke control area is proposed, the Board's sales staff should immediately offer their services to the owner of any premises within the area who has existing appliances which are producing smoke. The closest co-operation with the local smoke inspectors is of the utmost importance and they will invariably appreciate any help the industrial engineer can give them with their more difficult problems. The opportunity often presents itself for the application of heating to be so modified that such other benefits are obtained in addition to the abolition of smoke that the user welcomes the introduction of gas-firing instead of feeling that it is something which has been forced upon him.

So far the smokeless zones and smoke control areas have contained little industrial plant. In a recently scheduled smokeless area in Manchester there was only one offending industrial appliance—a crude furnace using wood and other types of solid fuel for annealing of chains. The user was persuaded to instal a properly designed gas-fired furnace and is now delighted with the improvement in output and control as well as reduction in overall costs per ton of chain.

A firm in the West Midlands area was using a coal-fired boiler to provide steam for sugar boilers, hot plates, etc. The introduction of the Clean Air Act, together with severe competition from other sweet manufacturers, led to an investigation of production costs and the firm's own figures for fuel cost alone were £7 per ton of sweets made. The whole of the plant has now been changed over to gas and the steam boiler shut down. The fuel cost now is approximately £3 per ton of sweets made.

Smokerooms

In addition to industrial process plant there are many coal-fired commercial and ancillary plants which may have to be altered to suit the requirements of smoke control zones either by conversion to gas-firing, or replacement by new gas-fired appliances. Many installations have already been carried out for both hot water

and steam boilers, bakers, ovens, fish ranges, etc.

One of the problems confronting local authorities when setting up a smoke control area is how to deal with smokerooms for the curing of bacon, ham, sausage, etc. While such an establishment by its very nature must produce some smoke, it is interesting to note that when gas-heated smoke units are used supplemented with independent heating of the smokehouse, much greater operational control is possible and the smoke emission can be greatly reduced.

The Clean Air Act deals primarily with reduction in smoke and grit emission and makes no attempt to impose restrictions on what many people believe to be the greater evil—the emission of oxides of sulphur into the atmosphere. The City of Manchester Corporation, who have always been crusaders in the field of smoke abatement, were the first local authority to obtain Parliamentary approval of a smokeless zone. Once more they have established their pioneering outlook by declaring that, as gas and electricity are the only two heating media which virtually produce no sulphur dioxide at the point of utilisation, all municipal buildings shall be heated by one or other of them, and as a result, many gas installations have already gone in and many more enquiries are in hand.

Perhaps the greatest claim that the gas industry can put forward for its continued expansion is that of all fuels, including electricity, it causes the least emission of sulphur dioxide into the atmosphere per useful therm of delivered heat.

A number of scheduled works are covered by the alkali inspectors instead of the local authorities with regard to atmospheric pollution. The list includes ceramic works using coal or oil-firing in intermittent kilns.

In the 1958 Alkali Inspector's report it is stated that the greatest number of complaints received (43) related to ceramic works, but acknowledgement is paid to the great achievement in smoke abatement which has already been made by the industry in the last twenty-five years by the use of gas and other smokeless fuels.

Under the Food and Drugs Act, 1955 is a regulation that all premises in which food is handled must provide an adequate supply of hot water to ensure both the personal hygiene of the staff and the general cleanliness of the equipment and premises. This mainly affects commercial premises and it has opened up a considerable market for increased hot water appliance sales. The Gas Council has previously issued booklets covering this aspect.

Most people at some time must reflect on the fundamental value of their own work to the community. The industrial engineer must derive great personal satisfaction from seeing not only the number of ways in which he is able to assist a manufacturer to improve production, quality and output but the many ways in which he can help him to conform with Parliamentary Acts primarily designed to improve the safety, healthy, and welfare of the factory employees and other personnel.

High temperature ammonia dissociators

FOR some years the use of 75% hydrogen/25% nitrogen mixtures, derived from cracked ammonia, has grown steadily. More recently the high temperature cracker has increased in popularity as it obviates the necessity of water scrubbing to remove residual ammonia. In consequence, the benefits of the extremely low oxygen and water vapour concentrations obtained in ammonia crackers are maintained, without the high capital cost of additional drying and other purifying equipment.

Special catalyst

Using a specially developed catalyst with exceptionally long life and high activity, high temperature ammonia crackers are now being produced by the Gas Atmospheres Division of the Incandescent Heat Co. Ltd., to the design of the Drever Co., Bethayres, U.S.A. These plants have outputs from 150 to 5,000 s.c.f.h. and are produced in ten standard sizes.

High temperature cracked ammonia is used in the heat treatment of metals, sintering, welding, controlled nitriding, degassing of metal parts and in metal cleaning by the the sodium hydride process.

BURNING WASTE GASES IN CARBON BLACK PRODUCTION

THE Chinese, who many centuries ago first produced lamp black, would be lost in the complex series of units which make up the plant used in the modern production of carbon black. Automatic feeds, collecting hoppers and pneumatic conveying systems have replaced the rooms in which various oils were burnt with a restricted air supply, the resulting fine black powder being scraped from the walls by hand.

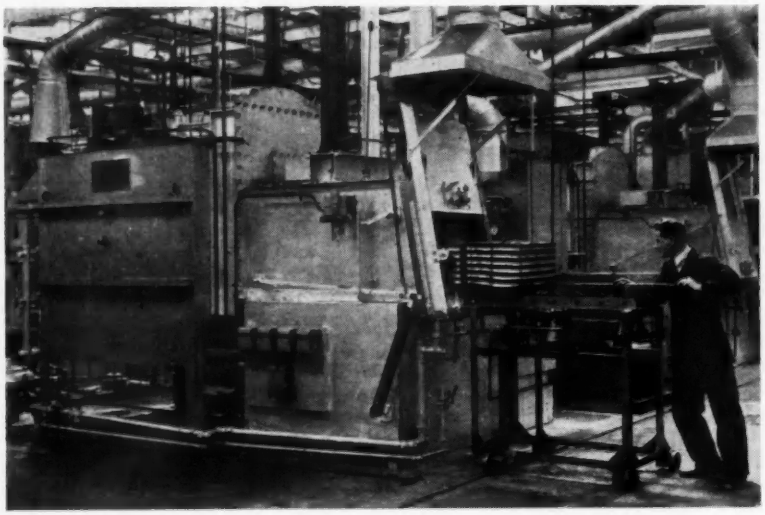
One of the most modern plants of its kind in Europe is that of the Ship Carbon Co. Ltd., at Basildon, Essex, which is capable of producing between 4,000 and 5,000 tons of carbon black per annum using as the raw material either coal tar distillates or heavy oils. Much of the production is supplied direct to tyre manufacturers, while at their Chadwell Heath, Essex, factory electrodes are manufactured for arc lights used in all parts of the world.

The burning and cracking reactions take place beneath a 'bell'—an inverted funnel about 6 ft. in diameter at the mouth—the air supply being controlled so that not more than 25% of the raw material is completely burnt. From here, the hot carbon-laden gases pass through a series of 16 refractory lined gravity collecting hoppers. The carbon is removed by a pneumatic system which conveys the bulky powder to storage bins in the packing department. Before the gases are finally discharged they pass through filter cabinets which remove the last traces of dust.

Some 5,000 cu.ft. per minute of waste gases result from the process and contain 30-40 parts per million of poisonous hydrogen sulphide which must be converted to water vapour and sulphur dioxide before being discharged to the atmosphere. This is done by burning the gases with air in an underground flue at a temperature of approximately 500°C. The calorific value of the gases, however, is only about 20 B.t.u. per cu.ft., which is insufficient to support combustion.

The Industrial Section of the North Thames Gas Board were approached on this unusual problem for a burner to provide ignition and maintain the burning reactions. A Hypact nozzle burning 1,200 cu.ft. of town gas per hour was chosen because the large area and turbulence of the flame would ensure that all the waste process gases must pass through it. This very simple arrangement effectively removes all traces of hydrogen sulphide from the gases which are finally discharged.

THE VERSATILE "ALCASE" FURNACE



Processes—

With an operating temperature range of 1,400° to 1,750°F., the following controlled atmosphere processes can be carried out.

1. Gas Carburizing.
2. Hot Oil or Marquenching.
3. Clean Hardening.
4. Dry Cyaniding or Carbonitriding.
5. Carbon Restoration.
6. Homogeneous Carburizing.
7. Clean Annealing.

The two "Allcase" furnaces

illustrated are at the works of a leading motor manufacturer, and are used for carburizing and carbonitriding steering and other parts requiring various case compositions and depths. The hearth area of each furnace is 3' 0" X 2' 0" with 1' 6" permissible depth of charge, and is designed to accommodate gross charge weights varying from 900 lbs. at 750°C. to 500 lbs. at 950°C.

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